भारतीय मानक

Indian Standard

IS 5282 (Part 4) : 2023

गुरुत्वाकर्षण तरल अवसादन विधियों द्वारा कण आकार वितरण का निर्धारण भाग 4 संतुलन पद्धति

(पहला पुनरीक्षण)

Determination of Particle Size Distribution by Gravitational Liquid Sedimentation Methods

Part 4 Balance Method

(First Revision)

ICS 19.120

भारतीय मानक ब्यूरो
BUREAU OF INDIAN STANDARDS
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Sieves, Sieving and Other Sizing Methods Sectional Committee, CED 55

FOREWORD

This Indian Standard (Part 4) (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Sieves, Sieving and Other Sizing Methods Sectional committee had been approved by the Civil Engineering Division Council.

Gravitational sedimentation particle size analysis methods are based on the settling velocity, under a gravitational field of particles in a liquid. This method is widely used for determining size distribution of many particulate materials. Typically, the gravitational methods apply to samples in the 0.5 µm to 100 µm size range and where the sedimentation condition for a Reynolds number < 0.25 is satisfied.

The choice of the most suitable method for determination of size distribution depends upon factors like:

a) The purpose for which the analysis is required;
b) The size range and density of particles;
c) The important properties of powder;
d) The amount available for test; and
e) The method by which the gross sample has been collected.

Due to the inherent characteristics of the different materials and the factor stated above, it is not possible to apply a single method of size analysis. This standard recommend procedures that may be applied in the majority of cases. The purpose of this standard is to provide uniformity in procedure for any gravitational method selected to facilitate comparisons of size analysis data.

This standard was first published in 1969 with the title 'Liquid sedimentation methods for determination of particle size of powders'. In this revision, to incorporate the latest advancement in gravitational liquid sedimentation methods for determining size distribution of particulate materials, the gravitational liquid sedimentation method has been grouped into four parts.

This standard (Part 4) describes a method to determine particle size distribution by use of the mass of particles deposited at a balance. This method is based on a direct mass measurement and gives immediately the mass-based distribution of particle diameter. This method does not use any fitting parameters. The results obtained are Stokes diameters. The other parts in the series are:

Part 1 General principles and guidelines

Part 2 Fixed pipette method

Part 3 X-ray gravitational technique

In the formulation of this standard due weightage has been given to international co-ordination among the standards and practices prevailing in different countries in addition to relating it to the practices in the field in this country. This has been met by deriving assistance from the following publications:

ISO 13317 (Part 1) Determination of particle size distribution by gravitational liquid sedimentation methods: Part 1 General principles and guidelines

ISO 13317 (Part 2) Determination of particle size distribution by gravitational liquid sedimentation methods: Part 2 Fixed pipette method

ISO 13317 (Part 3) Determination of particle size distribution by gravitational liquid sedimentation methods: Part 3 X-ray gravitational technique

ISO 13317 (Part 4) Determination of particle size distribution by gravitational liquid sedimentation methods: Part 4 Balance method

The composition of the Committee responsible for the formulation of this standard given in Annex C.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 2022 'Rules for rounding off numerical values (*second revision*).' The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

DETERMINATION OF PARTICLE SIZE DISTRIBUTION BY GRAVITATIONAL LIQUID SEDIMENTATION METHODS

PART 4 BALANCE METHOD

(First Revision)

1 SCOPE

1.1 This standard (Part 4) covers balance method for the determination of particle size distribution by the mass of particles settling under gravity in liquid. This method is based on a direct mass measurement and gives the mass distribution of equivalent spherical particle diameter.

1.2 The methods of determining the particle size distribution described in this standard are applicable to samples in the 1 µm to 100 µm size range and where the sedimentation condition for particle Reynolds number less than 0.25 is satisfied.

2 REFERENCES

The standards listed in Annex A contain provisions that, through references in the text, constitute provisions of this standard. At the time of publication, the edition indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent edition of these standards.

3 TERMS AND DEFINITIONS

For the purpose of this standard, the definitions given in IS 4124 and IS 5282 (Part 1), and the following shall apply.

3.1 Apparent Particle Density

Particle mass divided by the volume it would occupy including all internal pores.

4 PRINCIPLE OF METHOD

This method is based on particle settling in a gravitational field and uniformly dispersed particles at start (homogeneous technique). The relationship between settling velocity v, that means the time t required to settle the distance h, is defined by the following equation according to stokes law.

$$v = \frac{h}{t} = \frac{(\rho_s - \rho_l) g\, x^2}{18\eta} \quad \ldots (1)$$

From equation (1), the stokes diameter x is directly obtained.

$$x = \sqrt{\frac{18\eta\, h}{(\rho_s - \rho_l) g t}} \quad \ldots (2)$$

where

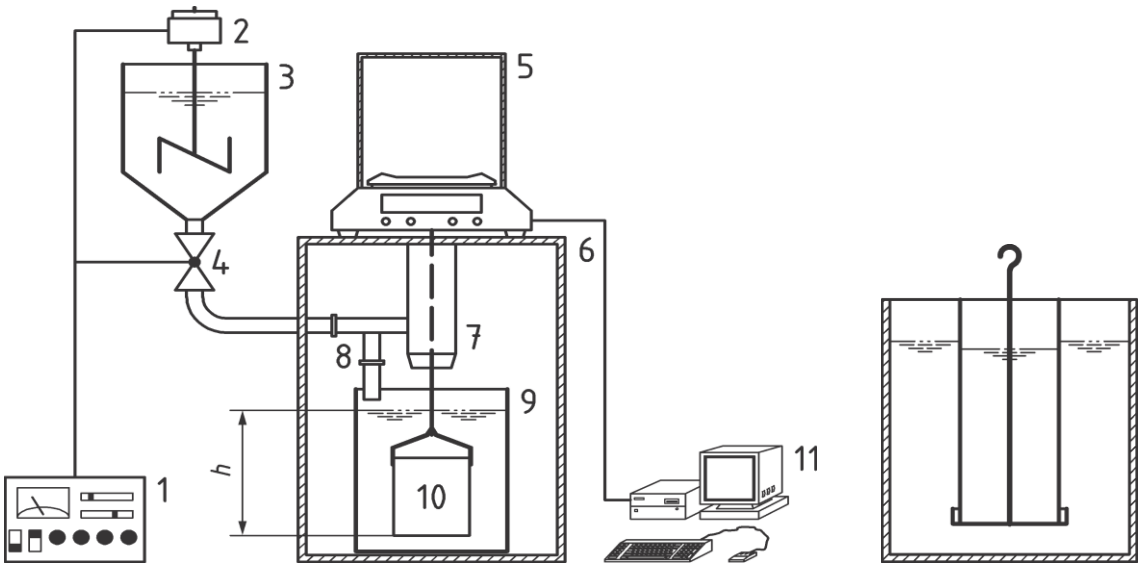
v = Settling velocity;
h = Sedimentation distance in m;
ρ_s = Apparent particle density in kg.m^{-3};
ρ_l = Liquid density in kg.m^{-3};
g = Gravity acceleration in m.s^{-2};
x = Particle diameter corresponding to time t required to move distance h in m; and
η = Liquid viscosity in Pa.s.

The above equation can be applied for Reynolds numbers of sedimenting particles less than 0.25. The determination of the particle size by gravitational sedimentation is a cumulative method. In this case, the method determines the rate at which solid particles settle from the suspension in a known volume of cylindrical vessel to a given distance. The mass of particles settled at time t is summed up from the mass of all particles of a diameter greater than x and in part of particles of diameters less than x. This method does not use any fitting parameters to obtain particle size distribution.

5 MEASUREMENT APPARATUS

5.1 Measurement Apparatus to Obtain the Mass of the Sediment

The apparatus measures continuously the increase of the mass of the particles sedimented out from the suspension. The apparatus shown in Fig. 1A typically consists of a sedimentation container and mass measuring system. Fig. 1B shows other type of sedimentation tray. For the mass measurement apparatus (electronic balance), detection precision shall be at least 1 percent of the total mass of particles in the detection tray.



1A 1B

Key

1	Controller	7	Main inlet pipe
2	Stirrer	8	Bypass
3	Dispersion bath	9	Sedimentation container
4	Valve	10	Detection tray
5	Precision electronic balance	11	Personal computer
6	Glove box		

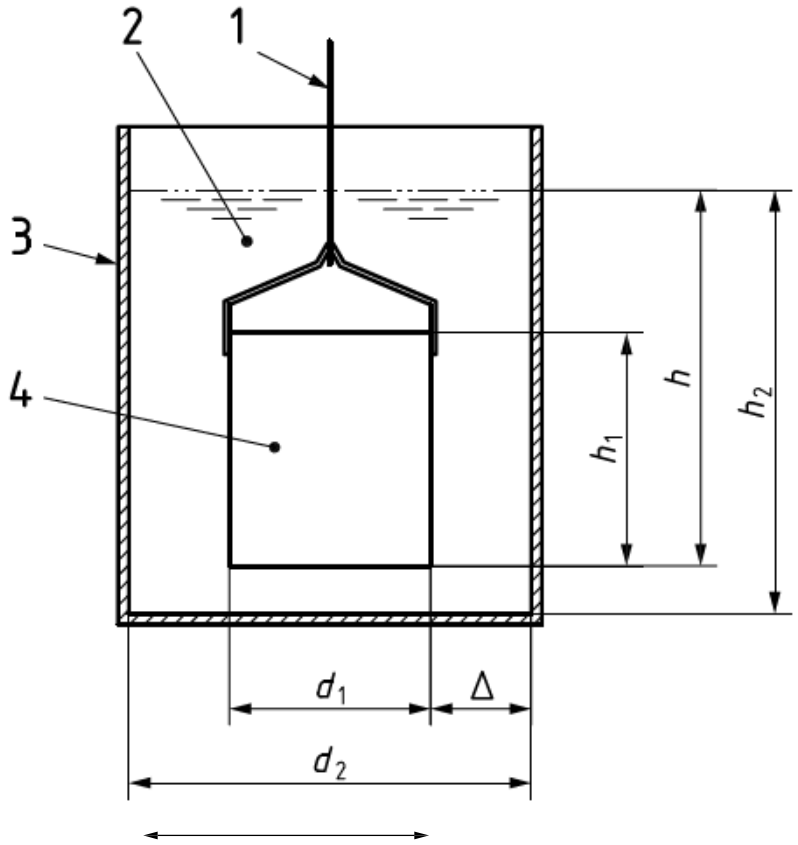
FIG. 1 MEASUREMENT APPARATUS — SEDIMENTATION BALANCE FOR PARTICLES IN LIQUID

5.2 Sedimentation Bath

A typical sedimentation bath is shown in Fig. 2. The detection tray has a cylindrical side wall and the clearance between the side wall of the tray and sedimentation bath shall be large enough to avoid interaction between them. Dimensions for the tray are shown in Fig. 2. The following ratios should apply:

$$0.88 < h/d_2 < 1.15, \quad 1.15 < h_2/d_2 < 1.48;$$

$$0.43 < d_1/d_2 < 0.71, \quad 0.61 < h_1/d_2 < 0.90.$$



Key

1 Support wire
2 Suspension
3 Sedimentation bath
4 Detection tray
h Sedimentation distance

FIG. 2 DETECTION CONTAINER

5.3 Dispersion Bath

In the bath, the particles have to be dispersed before measurement and the dispersion state has to be checked as per IS 18100 'Sample preparation — Dispersing procedures for powders in liquid'.

5.4 Measuring System

Figure 1 shows a schematic diagram of the measuring system. By use of a time-controlled valve, a precision electronic balance, and a personal computer, the cumulative mass of the sediment on the tray is automatically recorded.

6 MEASURING METHOD

6.1 Measurement of Density

The apparent particle density for the setting shall be measured as per IS 5282 (Part 1).

6.2 Preparation Method of Suspension

A sample division shall be as per IS 4897 and it shall be dispersed according to IS 18100 'Sample preparation — Dispersing procedures for powders in liquid' in a dispersion medium.

6.2.1 *Dispersion Medium*

When the test particles are not well dispersed by the dispersion medium, it is necessary to use a suitable dispersing agent. In this case, the dispersion medium should satisfy the following requirements:

a) Viscosity of the dispersion medium has to be in a suitable range regarding the sedimentation time.
b) Flocculation and agglomeration shall be avoided also during sedimentation process.

c) In the dispersion medium, the solid phase shall be insoluble, chemically and hydro-dynamically stable, and not change its volume.

d) Avoid using volatile liquid as sedimentation medium.

6.2.2 *Suspension*

A suitable amount of test particles, dispersion medium, and if necessary, a dispersion agent shall be well mixed in the dispersion bath.

The volume concentration of test particles in the dispersion medium should be less than 0.1 percent. At higher volume concentrations, the hindrance function accounting for the hydrodynamic hindered setting effect has to be taken into account. Particle setting velocity reads:

$$v = \frac{h}{t} = \frac{(\rho_s - \rho_l)\, g\, x^2}{18\eta} f(\varepsilon) \qquad \ldots (3)$$

$$\varepsilon = \frac{(1-w)\rho_s}{w\,\rho_l + (1-w)\rho_s} = 1 - \phi \qquad \ldots (4)$$

where

$f(\varepsilon)$ = sample specific hindrance function [*see* IS 5282 (Part 1)]; and

ε = liquid volume fraction.

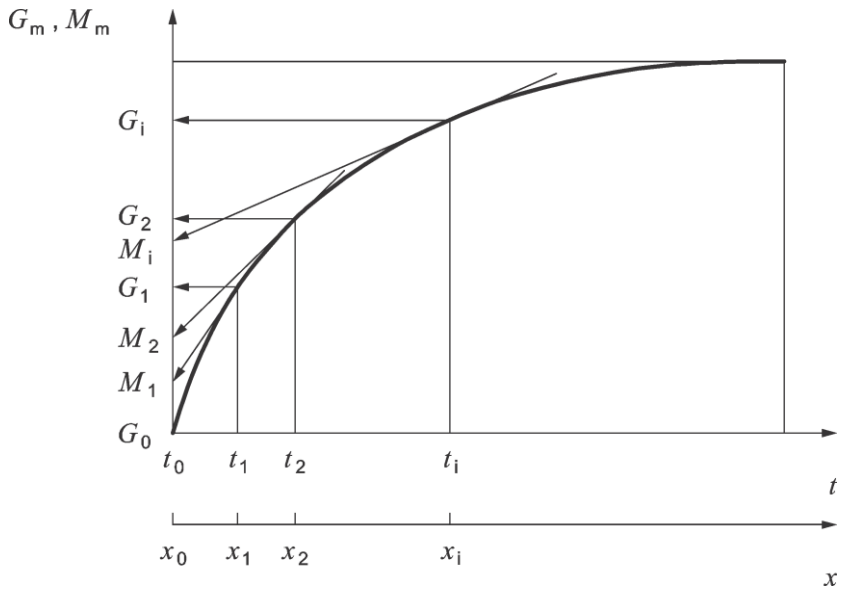
The values of ϕ and w are particle volume fraction and mass fraction, respectively.

6.3 Measurement

The following procedures shall be performed to take a measurement:

a) Have the dispersion medium prepared. The temperature of the dispersion medium should be constant during the preparation and measurement (*see* Annex B). Initial particle mass of w gram is given into a small beaker and 10 cm^3 of dispersion medium is directly added to the test particles and well mixed to prepare a pre-suspension. After adding the appropriate amount of dispersing medium, the supersonic vibration is applied to the pre-suspension. Finally, the necessary amount of dispersion medium has to be added, and the suspension has to be well mixed. After stirring of the suspension, it is supplied to the sedimentation bath and the measurement is started. During the preparation and the supply of the suspension to the dispersion bath, air bubbles shall be avoided; and

b) The measurement is stopped when all particles are settled down and the mass of sediment shows no further increase. In the case that fines are still suspended in the dispersion, the suspension is sampled with a siphon. After drying the suspension, the mass of the fines is determined.



Key

t Time, in s

x Particle diameter, in µm

FIG. 3 TYPICAL SEDIMENTATION CURVE

6.4 Data Analysis

Figure 3 depicts a typical record from the balance indicating the mass increase of the sediment with time. This is the sedimentation curve $G(t)$. In Fig. 3, G_i is the mass at the sedimentation time t_i, and M_i is the intercept of the tangential line at the point (t_i, G_i) of the sedimentation curve. When the mass of sediment reaches a constant value G_m (*see* Fig. 3), maximum time, corresponding to the minimum stokes diameter, is obtained assuming that all particles have the same apparent density.

6.4.1 *Differential Method*

a) Sedimentation times t_1, t_2, …, t_n corresponding to particle diameters x_1, x_2, …, x_n are calculated using equation (1).

$$t_i = \frac{18\eta h}{g(\rho_s - \rho_l){x_i}^2} \quad \ldots (5)$$

In case of volume concentrations higher at 0.1 percent, equations (3) and (4) apply.

$$t_i = \frac{18\eta\, hf(\varepsilon)}{g(\rho_s - \rho_l)x_i^2} \quad \ldots (6)$$

b) From the experimental sedimentation curve, the relation between the sedimentation time and mass of sediment is obtained (*see* Fig. 3). For each particle diameters x_1, x_2, …, x_n corresponding to sedimentation times t_1, t_2, …, t_n, a tangential line is drawn and by extrapolating the tangential lines to the ordinate, the values of intercepts M_1, M_2, …, M_n are obtained. These values are proportional to the cumulative distribution by mass for the particle classes of diameters $x_1, x_2 \ldots x_n$;

c) The cumulative distribution by mass for the particle diameter x_i is calculated as follows:

$$Q_{3,i} = 1 - \frac{M_i}{M_{Max}} \quad \ldots (7)$$

where

$Q_{3,i}$ = Cumulative distribution by mass;
M_i = Cumulative mass for the particle diameter greater than x_i; and
M_{Max} = Total massof particles.

For the case that small particles are left in the sedimentation bath, the mass of suspended small particles in the cylindrical volume of the detection tray shall be determined by the method in **6.3**(b). The mass of sediment is the sum of the final data of the sedimentation curve and mass of the particles left in the sedimentation bath.

6.4.2 *Data Reduction by Matrix Method*

When the masses of particles at time $t = t$ and $t = t_{end}$ are represented by G_t and G_m respectively, the following equation may be applied.

$$\frac{G_t}{G_m} = \int_0^{x_{Max}} g(t,x)q_3(x)dx \quad \ldots (8)$$

The value of $g(t,x)$ is defined as follows:

$$g(t,x) = \frac{v(x)t}{h} : 0 < x \leq x_e \quad \ldots (9)$$

$$g(t,x) = 1 \quad : x_e < x \leq x_{Max} \quad \ldots (10)$$

where

x_e = Particle diameter corresponding to the particle which requires time t to pass the sedimentation distance h;
x_{Max} = Maximum particle diameter;
$v(x)$ = Sedimentation velocity for a particle of diameter x;
$g(t,x)$ = Response function; and
$q_3(x)$ = Distribution density by mass in m^{-1}.

By using equation (8) for each particle size range, a matrix is obtained. Particle size distribution $q_3(x)$ is determined by solving the matrix through iterative procedure.

7 ACCURACY

The theoretical maximum sedimentation mass G_m is calculated by equation (11).

$$G_m = W\frac{V_1}{V}\frac{\rho_s - \rho_l}{\rho_s} \quad \ldots (11)$$

Due to the uncertainty of the apparent particle density, the uncertainty of the theoretical sedimentation mass is estimated by equation (12).

$$\Delta G_m = \sqrt{\left(\frac{\partial G_m}{\partial \rho_s}\Delta\rho_s\right)^2} = \sqrt{\left(W\frac{V_1}{V}\frac{\rho_l}{{\rho_s}^2}\Delta\rho_s\right)^2} \quad \ldots (12)$$

Due to the uncertainty of the apparent particle density, the uncertainty of the Stokes diameter is calculated from equation (13).

$$\Delta x = \sqrt{\left(\frac{\partial x}{\partial \rho_s}\Delta\rho_s\right)^2} = \sqrt{\left(\frac{18\eta h}{4\,gt}\right)\frac{1}{(\rho_s-\rho_l)^3}\Delta{\rho_s}^2} \quad \ldots (13)$$

where

W = initial particle mass in volume; and
V_1 = the volume of the detection tray from liquid surface to the tray bottom.

8 SIZE RANGE OF MEASUREMENT

Maximum and minimum particle diameters (x_1 µm to x_2 µm) should be in the range determined by the following equation:

$$x_1 = \sqrt{\frac{18\eta\, h}{(\rho_s-\rho_l)gt_1}} \quad x_2 = \sqrt{\frac{18\eta\, h}{(\rho_s-\rho_l)gt_2}} \quad \ldots (14)$$

where

t_1 and t_2 Correspond to maximum and minimum measuring time, respectively.

On the other hand, the maximum size has to be determined by equation (15).

$$x_1 \leq 0.25\ \frac{\eta}{\rho_l \nu} \quad \ldots (15)$$

9 REPORTING OF RESULTS

The measurement results can be illustrated by a figure whose abscissa depicts equivalent particle diameter and ordinate displays the corresponding cumulative distribution. A worked-out example is given in Annex B.

The report shall state the following:

a) sample;
b) sample apparent density;
c) sample mass and concentration;
d) suspending liquid;
e) temperature;
f) liquid density;
g) liquid viscosity;
h) dispersing agent and concentration;
j) instrument used;
k) method of dispersion;
m) suspension volume;
n) minimum and maximum time; and
p) any other information which could have an influence on the results.

ANNEX A

(*Clause* 2)

LIST OF REFERRED STANDARDS

IS No.	*Title*
IS 4124 : 1981	Glossary of terms relating to powders (*first revision*)
IS 4879 : 2023	Method of sub — Division of gross sample of powder used for determination of particle size
IS 5282 (Part 1) : 2023	Determination of particle size distribution by gravitational liquid sedimentation methods: Part 1 General principles and guidelines (*first revision*)
IS 8883	Methods of sampling chemical and chemical product:
(Part 1) : 2005	General requirements and precautions (*first revision*)
(Part 2)	Sampling equipment,
(Sec 1) : 1978	For solids
(Sec 2) : 1978	For liquids
(Sec 3) : 1978	For gases
IS 18100 : 2022	Sample preparation — Dispersing procedures for powders in liquids

ANNEX B

(*Clauses* 6.3 *and* 9)

DATA REDUCTION BY MATRIX METHOD

B-1 EXPERIMENTAL CONDITIONS

a) Temperature control is necessary to avoid convective flow due to local liquid density difference and to know the exact material properties according to equation (1). The temperature control should ensure a measurement temperature of ± 1 K. Change of temperature with time should be less than 0.05 k/min; and

b) Any vibrations as well as air circulation in the place of the measurement apparatus have to be avoided.

B-2 DATA REDUCTION BY MATRIX METHOD

Data reduction by use of differential method on sedimentation curves sometimes causes errors due to the differential processing of curve. On the other hand, this error can be reduced by data reduction by means of the matrix method.

When the mass of particles at time $t = t$ and $t = t_{\mathrm{end}}$ is represented by G_{ti} and G_{m} respectively, and sedimentation distance by h, equation (16) is satisfied.

$$\frac{G_{\mathrm{ti}}}{G_{\mathrm{m}}} = \int_{x_{\mathrm{e}}}^{x_{Max}} q_3(x)dx + \int_0^{x_{\mathrm{e}}} \frac{v(x)t_{\mathrm{i}}}{h} q_3(x)dx \quad \ldots (16)$$

Particle size distribution at time t_{i} is denoted by $q_{3,i}(x)$, Equation (17) is satisfied.

$$g(t_{\mathrm{i}}) = G_{\mathrm{m}} \int_0^{x_{Max}} g(t_{\mathrm{i}}, x)\, q_{3,\mathrm{i}}(x)dx = (\mathrm{i} = 1, \ldots, n) \quad \ldots (17)$$

$$g(t, x) = \frac{v(x)t}{h} (0 < x \leq x_{\mathrm{e}}) \quad \ldots (18)$$

$$g(t, x) = 1(x_{\mathrm{e}} < x \leq x_{Max}) \quad \ldots (19)$$

Discretising Equation (17), Equation (20) is obtained.

$$q_{3,\mathrm{i}}{}^{(\mathrm{k}+1)}(x) = \{1 - g(t_{\mathrm{i}}, x)\} q_{3,\mathrm{i}-1}{}^{(\mathrm{k})}(x) + \gamma_{\mathrm{i}}{}^{(\mathrm{k})} g(t_{\mathrm{i}}, x) q_{3,\mathrm{i}-1}{}^{(\mathrm{k})}(x) \quad \ldots (20)$$

$$\gamma_{\mathrm{i}}{}^{(\mathrm{k})} = \frac{G(t_{\mathrm{i}})}{G_{\mathrm{m}} \sum_{\mathrm{j}=1}^{\mathrm{m}} g(t_{\mathrm{i}}, x) q_{3,\mathrm{i}-1}{}^{(\mathrm{k})}(x_{\mathrm{j}}) \Delta x_{\mathrm{j}}} \quad \ldots (21)$$

Converged solution can be obtained with iterative procedure assuming initial particle size distribution $q_{3,\mathrm{i}}{}^{(0)}(x)$. Converged solution is obtained when equation (22) is satisfied.

$$\sum_{\mathrm{j}=1} \left| q_{3,\mathrm{i}}{}^{(k+1)}(x_{\mathrm{j}}) - q_{3,\mathrm{i}}{}^{(k)}(x_{\mathrm{j}}) \right| < \varepsilon \quad \ldots (22)$$

where

$q_{3,\mathrm{i}}$ = Cumulative distribution by mass for particle diameter x_{i};

$q_{3,\mathrm{i}}(x)$ = Distribution density by mass at time t_{i} in m^{-1};

m = Division number of particle size; and

Δx_{j} Width of the particle size interval j.

B-3 EXAMPLE OF MEASUREMENT

The example data of sedimentation mass are shown in Fig. 4 and Table 1. The Detection tray with the following dimensions (*see* Fig. 2) was used in the experi ent: $d_1 = 39$ mm, $d_2 = 70$ mm, $h = 80$ mm, $h_1 = 62$ mm, $h_2 = 104$ mm. The accuracy of the electronic balance was ± 0.01 mg. The data reduction was carried out based on the matrix method. The measurement results of the other two kinds of test particles (JIS No. 2 and 8) are also shown in Fig. 5.

a)	Sample	Barium titanate glass
b)	Sample apparent density	4 200 $\mathrm{kg.m^{-3}}$
c)	Sample mass and concentration	2 500 g, 0.62 weight percent
d)	Suspending liquid	Distilled water
e)	Temperature	293.15 K
f)	Liquid density	999 $\mathrm{kg.m^{-3}}$
g)	Liquid viscosity	1.005 mPa.s
h)	Dispersing agent and concentration	0.05 weight percent, sodium hexa-meta-phosphate, $(NaPO_3)_6$
j)	Instrument type used	Liquid sedimentation mass balance method
k)	Method of dispersion	Ultrasonic probe, 150 W, 10 min
m)	Suspension volume	400 cc
n)	Minimum and maximum time	1 s, 5 000 s

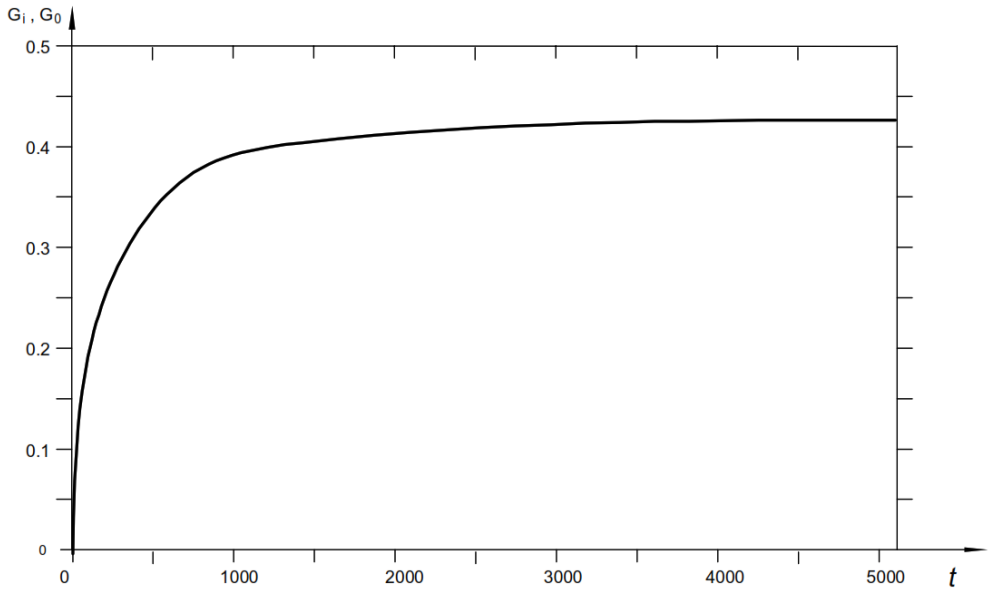
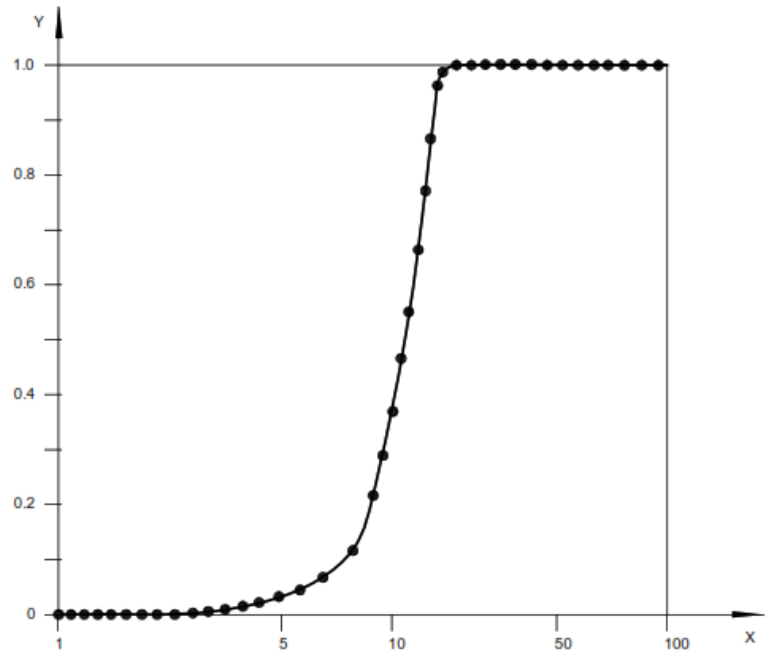


FIG. 4 EXAMPLE DATA OF SEDIMENTATION CURVE

Table 1 Example Data of Liquid Sedimentation Mass Balance

(*Clause* B-3)

$t(s)$	$G_i - G_0(g)$	$t(s)$	$G_i - G_0(g)$	$t(s)$	$G_i - G_0(g)$	$t(s)$	$G_i - G_0(g)$	$t(s)$	$G_i - G_0(g)$
1	0.0	34	0.079 6	67	0.162 1	100	0.221 2	2 500	0.422 7
2	0.0	35	0.081 9	68	0.164 4	110	0.235 4	2 600	0.423 1
3	0.0	36	0.084 1	69	0.157 6	120	0.248 3	2 700	0.423 5
4	0.0	37	0.086 3	70	0.168 1	130	0.259 9	2 800	0.423 9
5	0.006 1	38	0.088 5	71	0170 5	140	0.270 2	2 900	0.424 3
6	0.015 3	39	0.091 3	72	0.172 6	150	0.279 8	3 000	0424 7
7	0.017 4	40	0.094	73	0.174 6	160	0.287 7	3 100	0.425
8	0.023 2	41	0.096 3	74	0.176 8	170	0.295 8	3 200	0.425 5
9	0.016 7	42	0.099 1	75	0178 7	180	0.303 4	3 300	0.425 9
10	0.019 3	43	0.101 6	76	0.180 9	190	0.310 1	3 400	0.426 2
11	0.023 8	44	0.104 5	77	0.182 7	200	0.316 3	3 500	0.426 6
12	0.025	45	0.107	78	0.184 7	300	0.358 3	3 600	0.426 9
13	0.027 7	46	0.109 8	79	0.186 3	400	0.380 1	3 700	0.427 3
14	0.029 6	47	0.112 3	80	0.188 2	500	0.393 4	3 800	0.427 6
15	0.031 1	48	0.115	81	0.189 9	600	0.400 4	3 900	0.427 9
16	0.035 1	49	0.114 6	82	0.191 7	700	0.404 1	4 000	0.427 9
17	0.023 9	50	0.120 2	83	0.193 6	800	0.407	4 100	0.428 2
18	0.039 8	51	0.122 7	84	0.195 2	900	0.409 3	4 200	0.428 6
19	0.041 7	52	0.125 5	85	0.197 1	1 000	0.411 2	4 300	0.428 9
20	0.044 4	53	0.127 9	86	0.198 8	1 100	0.413	4 400	0.429 3
21	0.046 8	54	0.130 7	87	0.200 6	1 200	0.414 4	4 500	0.429 6
22	0.048 9	55	0.133 3	88	0.202 2	1 300	0.415 5	4 600	0.43
23	0.051 8	56	0.136 1	89	0.203 9	1 400	0416 4	4 700	0.430 2
24	0.054 5	57	0.138 6	90	0.205 4	1 500	0.417 4	4 800	0.430 5
25	0.056 8	58	0.141 3	91	0.207	1 600	0.418 1	4 900	0.430 7
26	0.059 5	59	0.143 7	92	0.208 5	1 700	0.418 7	5 000	0.430 8
27	0.061 7	60	0.146 4	93	0.210 1	1 800	0.419 3	–	–
28	0.064 5	61	0.148 6	94	0.211 7	1 900	0.419 9	–	–
29	0.066 9	62	0.151	95	0.213 4	2 000	0.420 5	–	–
30	0.069 7	63	0.153 1	96	0.214 9	2 100	0.421	–	–
31	0.071 9	64	0.155 5	97	0.216 6	2 200	0.421 5	–	–
32	0.074 6	65	0.157 6	98	0.218 1	2 300	0.422	–	–
33	0.077	66	0.16	99	0.219 7	2 400	0.422 4	–	–



Key

X equivalent diameter x, in µm
Y cumulative distribution by mass $Q_3\ (x)[-]$

FIG. 5 EXAMPLE OF PARTICLE SIZE DISTRIBUTION OBTAINED BY MASS BALANCE METHOD

ANNEX C

(*Foreword*)

COMMITTEE COMPOSITION

Sieves, Sieving and Other Sizing Methods Sectional Committee, CED 55

Organization	*Representative(s)*
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